THE UNIVERSITY OF ALBERTA


THE PREVALENCE OF MALOCCLUSION IN GRADE EIGHT
CHILDREN IN EDMONTON


by

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A THESIS

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ABSTRACT

The Prevalence of Malocclusion in Grade Eight
Children in Edmonton

The purpose of this study was to determine the prevalence of
malocclusion, the severity of malocclusion and the percentage of children
undergoing treatment for malocclusion in a random sample of young
adolescents.

The study was based on the examination of 464 Edmonton grade
eight children with a mean age of 13 years, 4 months and who comprised
5.58% of the total Edmonton grade eight population. Only children with
a full complement of teeth were accepted for examination. The subjects
were selected from ten different Junior High Schools each located in a
different geographic area of the city of Edmonton. The schools were
selected to provide equal representation of categories developed by the
Edmonton Public School Board to indicate socio-economic status of the
communities served by the respective schools. Further, the children were
individually rated as to low, middle or high socio-economic status. The
subjects were examined visually and a subjective method of evaluating each
child's occlusion was compared with the more objective Handicapping
Malocclusion Assessment Record (HMAR) (Salzmann, J.A., Am. J. Orthod.
54:1968) score obtained for each individual. The children studied were
grouped according to sex, school attended, occlusion and socio-economic
status and the data collected was subjected to statistical evaluation.

Malocclusion was found to be present in 88.36% of the sample,
while 62.5% of the sample were deemed to require comprehensive full-banded
orthodontic treatment to correct their malocclusion. The 48 children who

had received or were receiving treatment accounted for only 16.55% of the total number of children deemed to require comprehensive treatment. A highly significant (Pr.$\leq$0.01) correlation existed between the individual socio-economic status of the children and whether they were receiving orthodontic treatment. Significantly more girls with malocclusions were aware of their problem than boys with malocclusions (Pr.$\leq$0.05). Children attending schools with a lower socio-economic rating were less likely to have a dentist, more likely to be missing first molars and less likely to be receiving orthodontic treatment where required. Inter-school differences in the foregoing categories proved to be significant to at least the 1% level. A highly significant correlation (r=0.8901) (Pr.$\leq$0.001) existed between the subjective rating of malocclusions and the HMAR scores indicating that the HMAR index should prove satisfactory in determining treatment need in most cases of malocclusion, exclusive of psychological considerations.

ACKNOWLEDGEMENTS

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# INTRODUCTION

Epidemiology has been defined as the study of disease or disability under the natural condition of its occurrence, with control of the disease or disability as the ultimate objective[38].

Malocclusion, dental caries and periodontal disease have been designated as the three most prevalent categories of oral pathology[30].

Malocclusion is any variation in occlusion which is unacceptable esthetically or functionally to either the individual with the occlusion, or to the examining dentist[38].

The etiology of malocclusion involves both genetic and environmental factors. Due to the possible geographic factor in the distribution of malocclusion, epidemiological studies of malocclusion conducted elsewhere cannot be relied upon to provide adequate data regarding local conditions.

Information concerning the epidemiology of malocclusion would be important to public health authorities, university personnel training and research programs and to the dental profession at large.

There has been no previous attempt to assess the prevalence of malocclusion in Edmonton. Accordingly, the present investigation was undertaken in order to provide meaningful statistics to the dental and other health professions and provide a basis for comparison with similar studies in other centres. The specific objective was to select a random sample of young adolescents in order to determine:

  (1)  the prevalence of malocclusion,

  (2)  the severity of malocclusion, and

  (3)  the percentage of children undergoing treatment for that condition.

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Studies on the prevalence of malocclusion have been carried out since 1888. Numerous investigators[12,19,24,30,33,36,46] have surveyed various groups of children and used diverse classification criteria. Their sample groups ranged from 2 through 18 years of age and malocclusion was present in as few as 4.5% to over 90% of the sample. In the majority of the groups studied, however, malocclusion occurred in 44% to 80% of the sample.

In a 1945 study of Canadian children, Marshall[32] found that 52.5% of the 13 year old children studied had malocclusions. Massler and Frankel[33] in a 1951 study of Illinois children aged 14 to 18 years discovered the presence of malocclusion in 78.8% of their sample. In 1956 Newman[40] studied Newark, N.J., children between 6 and 14 years of age and found malocclusion in 52% of the children. Ast et al[4] in 1965 classified 95% of their sample of New York senior high school students aged from 15 to 18 years as having some form of malocclusion. In a 1966 study of 1,455 Maryland children between the ages of 8 and 17 years, Mills[36] determined the presence of malocclusion in 82.5% of the sample. Helm[27], in a 1968 study of Danish adolescents, found the prevalence of malocclusion to be 78.5%. In 1974 Jago[30] reviewed 45 studies on the prevalence of malocclusion. The results ranged from 4.5% to 100% having malocclusion present.

Massler and Frankel[33] summarized the three main reasons for the wide variation in the reported prevalences of malocclusion. First, the investigators not only had unlike objectives in mind, they also used diverse diagnostic criteria. Second, a wide range of different age groups were studied with the result that data on the primary, mixed and

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permanent dentitions were inextricably mixed. Third, in some studies only a small number of individuals were examined so that the findings were of doubtful statistical significance.

A number of methods of assessing and classifying malocclusions have been proposed since 1890. They range from a simple designation of "regular" and "irregular" occlusion (without, however, any definition of these terms) by Ottofy[41] (1890) to complicated systems proposed by Hellman[26] (1921), Korkhaus[31] (1928), Sclare[46] (1945) and Moore[37] (1948). Most of the early methods of assessment were based on Angle's[2] designation of "Normal" and "Abnormal" occlusion. Classifications of malocclusion in use today make use, in part, of Angle's designation of Class I, II and III molar and cuspid relationships.

Malocclusion can be defined by deviation from some standard of occlusal relationship. Angle[2] used the concept of ideal occlusion as his standard. Horowitz and Hixon[28], in 1966, observed that naturally occurring ideal occlusions were the exception rather than the rule. Consequently, the arbitrary concept of the ideal has validity only as a pattern or model of the dentition "as it ought to be", which, in practice serves as a therapeutic standard and goal. In this later connotation, most dentists and particularly orthodontists, have come to use the term malocclusion to describe conditions that deviate from the ideal. Ideal occlusion continues to be considered as our best concept of a desirable goal.

The Angle Classification System does not quantify the elements of occlusal disharmony, and cannot be used to measure the severity of such disharmony either in an individual or in a population. In spite of its quantitative limitations, the nearly universal use of Angle's classi-

fication in the past has made it virtually the only indicator of the prevalence of the different types of malocclusion in different populations.

Most of the investigators studying the prevalence of malocclusion did not measure the severity of malocclusion found. Massler and Frankel[33] attempted to evaluate the malocclusion as either "mild", "moderate" or "severe" but abandoned that approach during the course of their study since they felt that such evaluation could only be performed by one trained in clinical orthodontics.

Ast et al[4] classified 14.4% of their sample as having severe malocclusion present. This figure, they felt was a conservative estimate of those children with a handicapping condition for whom treatment was urgently needed. Banack et al[6], although not measuring the severity of malocclusion, concluded that 23.5% of their sample required treatment. Goose et al[19] determined that approximately 20% of their sample would require "appliance therapy" to correct malocclusion. Newman[40] concluded that 52% of the sample studied needed "some form of treatment".

Only a few of the investigators studying the prevalence of malocclusion recorded the percentage of children who had received or were undergoing orthodontic treatment at the time of examination. Ast et al[4] reported that 9.6% of their sample had received or were receiving orthodontic therapy "of some kind". Helm[27] noted that just over 1% of his sample had received or were undergoing orthodontic therapy at the time of the examination. Newman[40], found that less than 1% of the children examined were being treated or had been treated for malocclusion. Banack et al[6] found that 7.4% of the children with malocclusion were receiving treatment.

A more objective approach to classifying the occlusal status of
a person takes the form of an index of malocclusion[11,37,43,21]. Numerous
indices of malocclusion have been proposed. At least three of them:
The Handicapping Labiolingual Deviation Index (HLD) developed by Draker[11]
in 1958, The Treatment Priority Index (TPI) introduced by Grainger[21] in
1966, and the Index of the American Association of Orthodontists developed
by Salzman[43] in 1967 are currently in use. Carlos[9] in a critical review
of these indices, came to the following conclusions: "Both the validity
and the reliability (reproducibility) of an index of malocclusion should
be demonstrated before it can be accepted for widespread use. Selection
of statistical techniques for index evaluation requires an unambiguous
prior decision on the proposed use of the index. Different methods of
evaluation are appropriate when an index is intended for administrative
use (to establish treatment priority) than when intended for epidemio-
logic use, even though the same index may be involved. When an index is
to be used for epidemiologic surveys, such an index is valid if, in de-
scribing its use, an investigator provides a clear statement of what is
measured and how it is measured. This constitutes a working definition
of the disease or condition under study, and data collected and compar-
isons made on this basis are valid, even though other investigators might
not completely agree with the variables included or the methods of
measurement. In the evaluation of index reliability (also referred to as
reproducibility or precision) one is concerned with the level of compara-
bility between results when the index is applied to the same material by
different examiners, or by the same examiner on different occasions. Thus
the reliability of an index is a property quite distinct from its validity
and most of the conceptual difficulties connected with the evaluation of

validity do not arise. Furthermore, a measure of reliability may usually
be simply obtained from straightforward and well-known statistical
methods".

Freer[16] has warned that indices of malocclusion are not capable
of measuring handicap truly and are, at best, measuring occlusal status
as perceived by the clinician. In his 1963 study of the physiological
and socio-psychological significance of malocclusion Fisk[14] states: "In
addition to the importance given to the morphological aspects of maloc-
clusion, recognition must be given to those seemingly abstract qualities
of malocclusion, -- the physiological and psychological aspects which
are significant or have potential significance to the present or future
well-being of the patient. Indices must be related to the significance
of the condition that they symbolize, both from the physiological (dental
health aspects) and the psychological (appearance) standpoints".

Fisk[14] stated further: "We may postulate the significance of a
defect by comparing the frequency of its occurence in the total popula-
tions to the frequency with which treatment for it is sought. If a
particular defect is rarely seen in the consulting room but is nonethe-
less prevalent in the population, such a defect may not be significant in
the public mind. To the patient, a malocclusion manifests itself when it
causes him concern. The degree of concern may have no relation to the
degree of physical divergence or to future dental health". Cohen[10],
Garn[18], Baume[7], Salzman[42,43], Jago[30] and Baldwin[5] agree on the necessity
to include psychological factors in deciding what constitutes a malocclu-
sion. Jago[30] noted that although general agreement exists that socio-
psychological factors must be considered no objective way of measuring
these factors has yet been established. Isaacson et al[29] recently stated

that current measurement systems are inadequate for assessing the relationships between the occlusal morphology and the need for treatment based on either physiologic or psychologic considerations. In view of the foregoing both Isaacson et al[29] and Jago[30] concluded that the term malocclusion represents a value judgement at the present time.

Jago[30] in his 1974 study entitled "The Epidemiology of Dental Occlusion: A Critical Appraisal", concluded "Malocclusion is probably unique in epidemiological investigation insofar as it is not ordinarily understood to be necessarily abnormal. In its definition, furthermore, one finds both objective and subjective elements. The objective elements are contributed by clinicians and dental scientists and the subjective elements by patients, parents and dentist. The search for an absolutely objective index of malocclusion, therefore, may be futile. It will be pursued, nevertheless, since accurate assessment of occlusal variation is bound to be important for determining priority of need, under publicly funded programs, to estimate needs for treatment in a population, and to increase the profession's scientific knowledge".

## MATERIALS AND METHODS

The present investigation was based on the examination of 464 Edmonton grade eight children aged 12-14 years and was drawn from ten different schools. The sample comprised 8.2% of the grade eight population of the Edmonton Public School System (5660) or 5.58% of the total Edmonton grade eight population (8316) attending both Public and Separate School Systems. The schools were ranked according to an ordinal scale developed by the Edmonton Public School Board. Ranks on the scale were numbered 1-5 with a ranking of 5 having the highest socio-economic status. Two schools were chosen by the examiner from each rank in order to have a representative sample. The schools selected were distributed widely throughout the city and in all instances schools of the same socio-economic rank were widely separated geographically. In order to protect the anonymity of each school, the schools were assigned an alphabetical code from A to J inclusive.

Although each school was ranked according to the general socio-economic status of the surrounding community the socio-economic status of individual children attending the school could not be assumed to coincide with the rating given to the school. Accordingly, each child was classified as to high, medium or low socio-economic status on the basis of information provided by the returned questionnaire.

The School Board required that each child taking part in the study obtain prior parental consent. Consent forms (Fig. 1) were provided to the principals of the selected schools for distribution to the grade eight children prior to the examination date.

## I. EXAMINATION PROCEDURE

The instruments used for examination consisted of: a headlamp for

Dear Parent:

Edmonton grade eight students are being asked to participate in a dental survey to help determine the occlusion (bite) patterns present in children of this age group.

The survey will be conducted by a qualified dentist taking full-time post-graduate research training in the Faculty of Dentistry at the University of Alberta in Edmonton.

The visual examination of your child will take only a few minutes and will not be a complete dental examination since the purpose of the study is to study occlusion only.  All information will be kept anonymous.

Your cooperation would assist us in carrying out this survey and would be appreciated.

Please indicate on the form below if your child has your permission to participate as requested; and, if so, kindly supply the information indicated and return the form to school as soon as possible.

Thank you.

<div align="center">TEAR HERE PLEASE</div>

---

Please be advised that _____ may/may not (please
                              Name of Child

circle one) participate in the dental survey.

Signature of Parent or Guardian _____

Age of Child: _____

Address: _____     Telephone: _____

School: _____

Father's Occupation: _____

Mother's Occupation: _____

How long has your family lived in Edmonton? _____

Does your child suffer from any general health problems? _____

Name of family dentist _____

<div align="center">Fig. 1.    Parental Consent Form</div>

illumination of the mouth area, a dental mirror, a plastic millimeter ruler, a boley guage, cheek retractors, occlusal and buccal intra-oral mirrors and a Minolta intra-oral camera set-up with electronic flash attachment[25]. Examples of typical and of unusually interesting conditions were recorded on photographic film using the intra-oral camera set-up. Facial photographs could also be taken with this camera.

The examination was confined to those children whose permanent teeth (exclusive of third molars) had erupted.

The children were examined individually so that their answers to subjective questions would not be influenced by the presence of other children. No attempt was made to educate the children with regard to orthodontic or general dental health or to influence their answers to subjective questions. Each child was examined visually and the information recorded on the patient evaluation form (Fig. 2).

Variables pertaining to facial esthetics, general dental health and the state of intra-oral soft tissues were included on the orthodontic evaluation form to serve only as a guide to a thorough visual examination and a subsequent subjective analysis of the occlusion of each individual examined. The pertinent variables on the form which were considered to be directly related to occlusion and/or malocclusion are hereinafter outlined and elaborated upon to facilitate understanding of the diagnostic criteria used by the examiner in the subjective analysis of the occlusion of each subject.

II. ORTHODONTIC EVALUATION

1. Antero-Posterior Dental Inter-arch Relationships

    A. Angle's Classification of Molar and Cuspid Relations (Fig. 3)

    B. Anterior Crossbite - refers to maxillary incisors that are in

## Orthodontic Evaluation

### Facial Esthetics:

Profile:   Straight_____   Convex_____   Concave_____

Anteriorfacial view:   Symmetrical_____   Asymmetrical_____

Soft tissue Analysis:   _____

### Intra-Oral:

Tongue:   Size_____   Position at rest_____

Frenae attachments:_____

Teeth size_____   Shape_____   Position _____

Teeth missing or Non-erupted:_____

Crowding:_____   Spacing_____

Rotations:_____

Dental Health:   Good_____   Fair_____   Poor_____

Molar relation:   Right_____   Left_____

Canine relation:   Right_____   Left_____

Midlines:_____

Crossbite:   Ant._____   Post._____

Overbite: (%) _____   Overjet (mm.)_____

Jaw Size Relationship:_____

Skeletal Classification:_____

Congenital Defects:_____

### Functional

Pattern of Jaw Closure:_____

Occlusal Interferences:_____

Speech:_____

Habits:_____

### Evaluation of Occlusion:

Normal_____   Acceptable_____   Mild_____   Moderate_____

Severe_____

Is patient under orthodontic treatment at present?   _____

Has patient had orthodontic treatment in the past?   _____

Fig. 2.   Orthodontic Evaluation Form

INTER-ARCH DEVIATIONS
POSTERIOR

Normal occlusion

Angle
Class I Occlusion

Angle
Class II Occlusion

Mandibular teeth
distal to maxillary teeth

Mandibular teeth
mesial to maxillary teeth
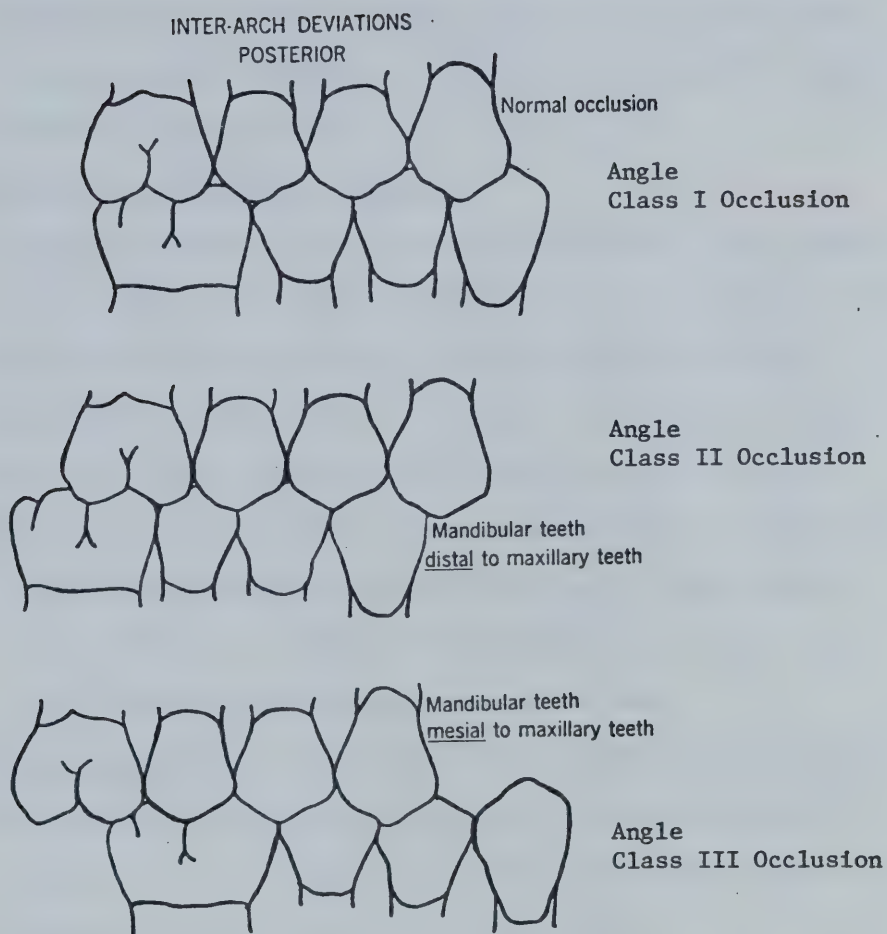
Angle
Class III Occlusion

Fig. 3.    Inter-arch deviations, posterior.

(From Salzmann, J.A.,  Am. J. Orthod. 54: 759, 1968.)

lingual relation to their opposing mandibular counterparts when the maxillary and mandibular dental arches are in centric relation (Fig. 4-A).

C. Overjet – refers to that condition in which the incisal edges of the maxillary incisors extend labially to the incisal edges of the mandibular incisors when the jaws are in centric relation (measured in millimeters).

2. Vertical Dental Inter-arch Relations

A. Overbite – refers to that condition in which the incisal edges of the maxillary incisors extend below the incisal edges of the mandibular incisors when the jaws are in centric relation (measured as a percentage of mandibular crown height). Deep Overbite (Plate 1-B) refers to an overbite in which 75% or more of the buccal aspect of the mandibular incisor crowns are covered by the crowns of the maxillary incisors when viewed from in front of the subject at an angle perpendicular to the incisal edges of the maxillary central incisors.

B. Anterior Openbite – refers to vertical inter-arch dental separation between the maxillary and mandibular incisors when the posterior teeth are in centric relation (Fig. 5-A). Edge to edge occlusion is not assessed as openbite.

C. Posterior Openbite – refers to the vertical interdental separation between upper and lower canines, premolars and first molars when the rest of the teeth in the dental arches are in centric relation (Fig. 5-B). Cusp to cusp occlusion is not assessed as openbite. When openbite is present with anteroposterior deviation or crossbite, both are scored. If one or more posterior

INTER-ARCH DEVIATIONS

A.

Anterior cross-bite

B.

Normal
buccolingual relation

Buccal cross-bite

Lingual cross-bite

Posterior cross-bite
B = Buccal
L = Lingual
P = Palatal
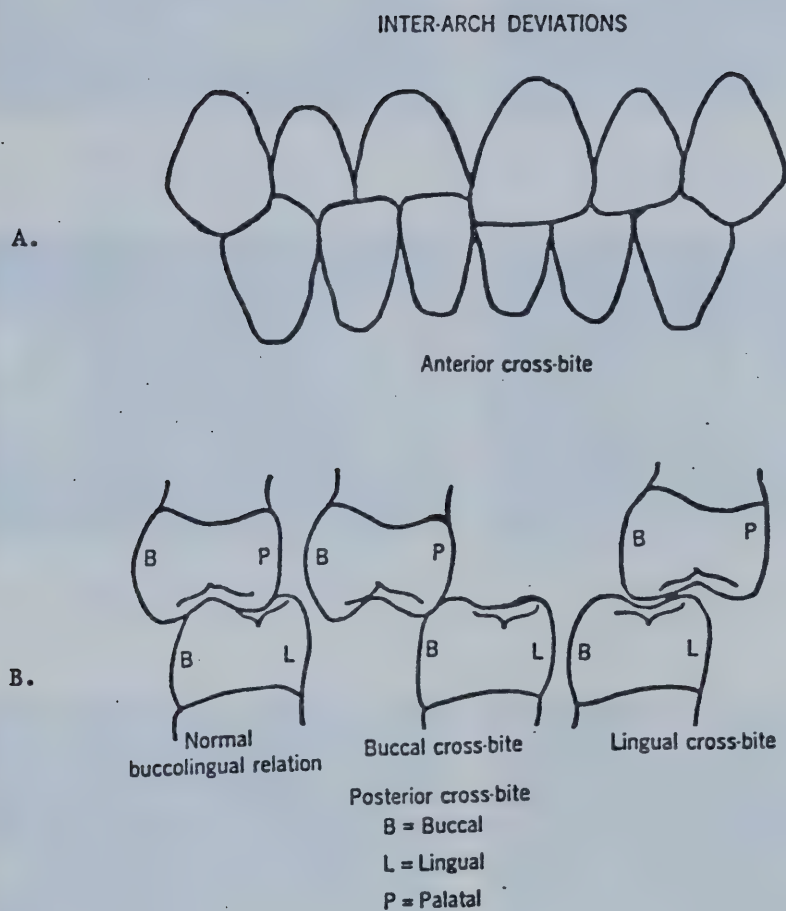
Fig. 4.    Inter-arch deviations.
A, Anterior crossbite.   B, Crossbite of posterior teeth.

(From Salzmann, J.A.,   Am. J. Orthod. 54: 758, 1968.)

A. Anterior Openbite



B. Deep Overbite
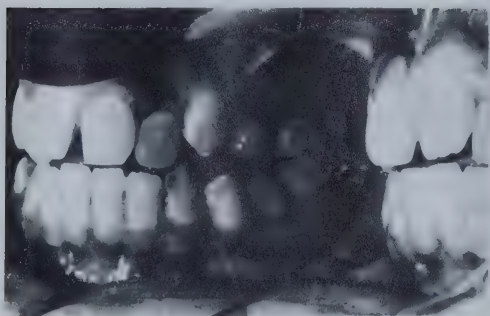


C. Anterior and Posterior
   Openbite



D. Anterior and Posterior
   Crossbite



E. Missing Teeth,
   Abnormal Lateral Incisor



F. Severely Crowded
   Maxillary Teeth

Plate 1.  Malocclusions
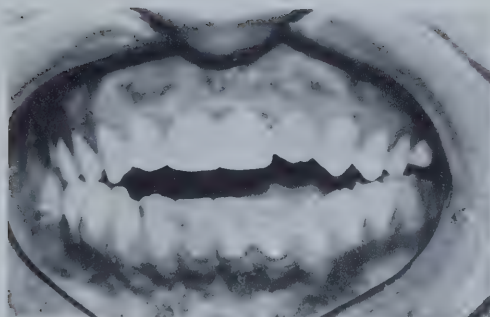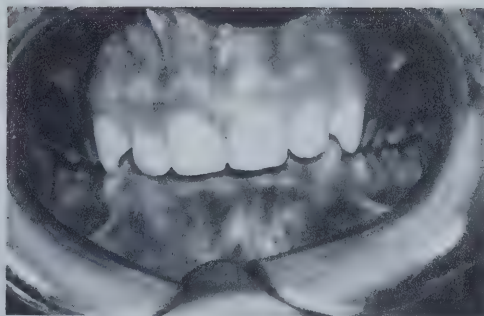
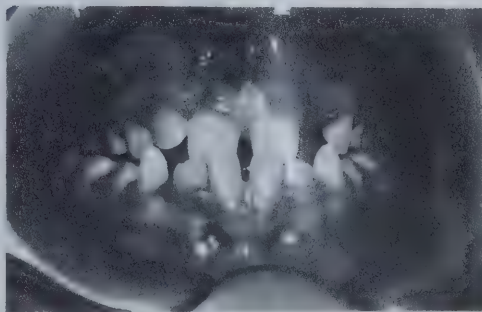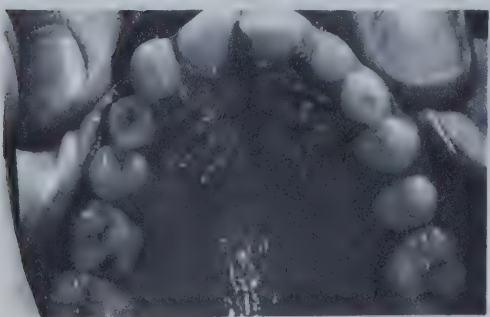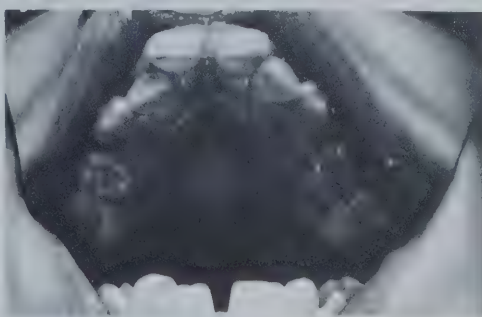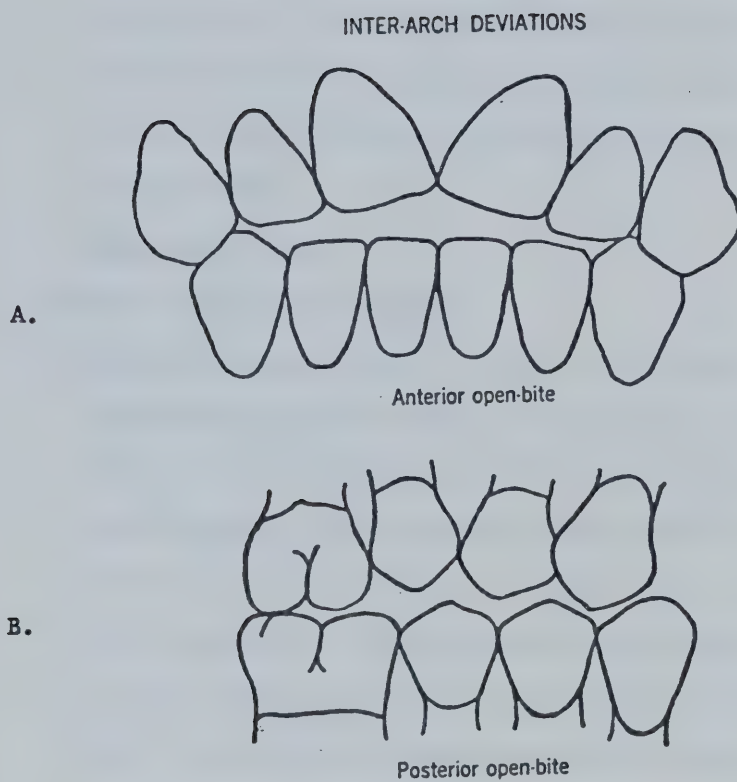Fig. 5.   Inter-arch deviations.
A, Anterior openbite.   B, Posterior openbite.

(From Salzmann, J.A.,  Am. J. Orthod. 54: 759, 1968.)

teeth are in openbite as well as an anterior openbite then both
conditions are scored.

3.  Lateral Dental Inter-arch Relations

    A.  Posterior Crossbite - refers to teeth in the buccal segment that
        are positioned lingually or buccally out of entire occlusal contact
        with the teeth in the opposing jaw when the rest of the teeth in
        the dental arches are in centric relation (Fig. 4-B).  When an
        anteroposterior deviation is present in addition to crossbite,
        both are scored.

    B.  Midline Relations

4.  Intra-arch Dental Relationships

    A.  Crowded (Displaced) Teeth - (Figs. 6 & 7) refers to positional
        irregularities of tooth crowns that interrupt the continuity of
        the arc of the dental arch and the space is insufficient for
        tooth alignment without moving adjacent teeth in the same arch.
        A tooth recorded as crowded is not also recorded as rotated.
        Major displacement occurs when both contact areas of the tooth
        are removed from their position in ideal alignment by 1.5 mm. or
        more.  In minor displacement both contact areas are removed from
        their position of ideal alignment but less than 1.5 mm. removed[48].

    B.  Rotated Teeth - (Fig. 6) refers to positional irregularities
        of tooth crowns that interrupt the continuity of the arc of the
        dental arch, but there is sufficient space for tooth alignment
        without the necessity of moving adjacent teeth in the arch.  A
        tooth recorded as rotated is not also recorded as crowded.  Major
        rotation is present when the angle formed by the line projected
        through the contact areas of the observed tooth and the ideal
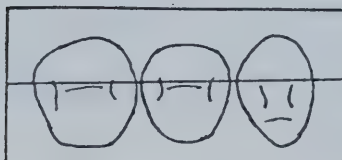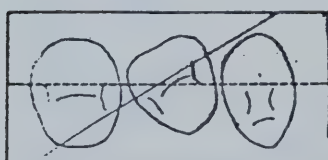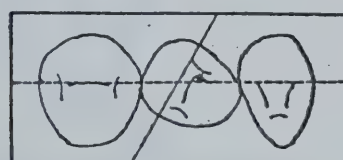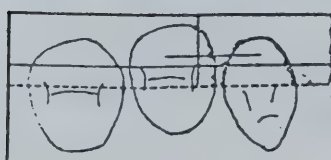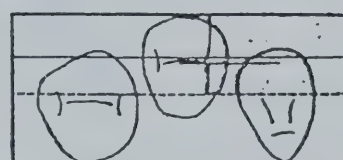
Fig. 6. Schematic of Malalignment Severity Rating
(From Van Kirk, L. E. and Pennell, E. H.
Am. J. Public Health, 49:  1159, 1959)

INTRA-ARCH DEVIATIONS



Anterior crowding

Missing
anterior tooth

Open space

Posterior
crowding

Closed posterior space
—tooth missing

Anterior spacing
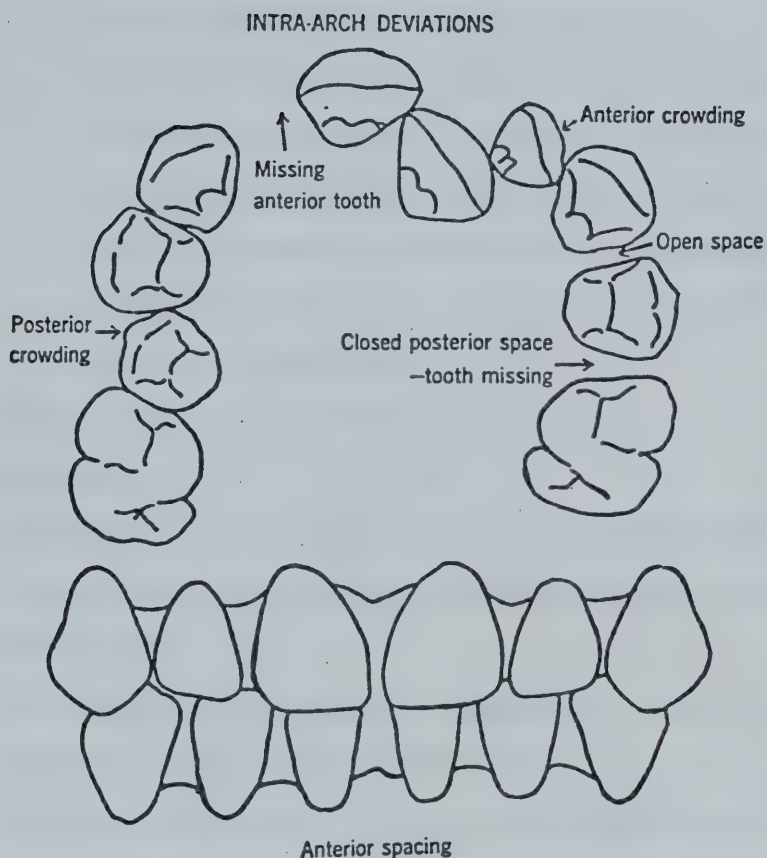
Fig. 7.  Intra-arch deviations.

(From Salzmann, J.A.,  Am. J. Orthod. 54: 757, 1968.)

arch is $45^{\circ}$ or larger.  In minor rotation the angle is less than $45^{\circ}$ [48].

C.  <u>Space Discrepancies</u> – (Fig. 7)

    a.)  Open Spacing – refers to tooth separation that exposes to view the crest of the interdental papillae.

    b.)  Closed Spacing – refers to space closure that will not permit a partially erupted tooth to complete its eruption without moving adjacent or other teeth in the same arch.  A tooth recorded as showing closed spacing is not also recorded as rotated or crowded.  A missing tooth with closed space is recorded as missing only.

D.  <u>Missing Teeth</u> – are assessed by actual count.

5.  <u>Miscellaneous</u>

A.  <u>Abnormal Tooth Morphology</u> – refers to congenital defects of erupted teeth which result in abnormal size and/or shape of these teeth.

B.  <u>Congenital Defects</u> – refers to developmental defects of the face and jaws such as facial and oral clefts.

C.  <u>Occlusal Interference</u> – refers to the presence of malpositioned teeth that interfere with lateral, protrusive or other excursive movements of the mandible.

D.  <u>Iatrogenic Removal of One or More First Bicuspids</u> – An iatrogenic condition was deemed to be present when the removal of one or more of the first bicuspids was deemed to result in one of the following sequelae:

    a.)  When the unilateral removal of only one first bicuspid in one or each arch resulted in a worsened midline relationship

between the two arches. This was observed by comparing the extracted arch with the antagonistic arch and/or to the midline structures of the face.

b.) In Class II cases when both maxillary first bicuspids were removed with resultant space closure from the distal and no correction of the severe overjet. In these cases there was no space into which to retract the protrusive anterior segment and further extractions would be indicated.

c.) When all four first bicuspids were removed resulting in severe deepening of the overbite and impingement of the lower incisors on the palate.

It should be noted that only in those situations where first bicuspid extractions were clearly not indicated as a means of alleviating a malocclusion and where their extraction compounded the problem was an iatrogenic condition considered to exist. Borderline cases were given the benefit of doubt and were not scored as having an iatrogenic component.

E. Occlusion - The examination included an assessment of centric relation, centric occlusion and functional movements of the mandible.

A wax bite registration of the occlusal surfaces of the dental arches in acquired centric occlusion was taken using Monsens Wax Bite Patterns. The purpose of these bite patterns was to provide a record of the inter and intra-arch dental and jaw relationships since the limitations of time and available facilities did not permit the taking of impressions for study casts.

III. PATIENT APPRAISAL

The children were asked the following questions to provide infor-

mation pertaining to general dental care and motivation and socio-economic status:

1. Did the child have a dentist? (Fig. 1)

2. How did the child feel about the appearance of his/her teeth?

3. Was the child receiving or had he/she received orthodontic treatment? If so, was the treatment by a dentist or an ortho-dontist? (Fig. 2)

4. What was the occupation of the father and of the mother, where applicable? (Fig. 1)

IV. SUBJECTIVE OCCLUSAL APPRAISAL

Each child's occlusion was classified as "ideal", "acceptable" or "malocclusion". Severity of each case of malocclusion was further subjec-tively evaluated as to whether it was considered "mild", "moderate" or "severe".

1. "Ideal" Occlusion was considered present when intra and inter-arch tooth relationships were considered perfect (as closely as could be ascertained by visual examination) (Plate 2).

2. "Acceptable" Occlusion was considered to be present in those children with a good interdigitation of both arches but in whom a few teeth were only slightly out of perfect alignment. In these cases no orthodontic treatment was considered necessary.

3. Malocclusion

A. "Mild" Malocclusion was considered present in those children presenting with a noticeable esthetic or functional deviation from the ideal, but requiring relatively short term palliative measures.

B. "Moderate" Malocclusion was considered present in those children who required comprehensive full-banded treatment to correct a
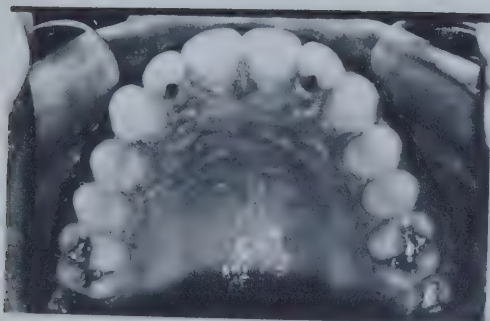
Maxillary Arch                    Mandibular Arch
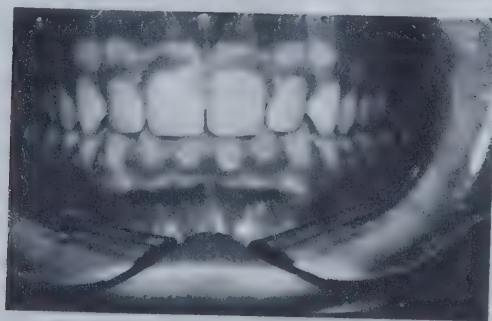


Anterior View -- Centric Occlusion
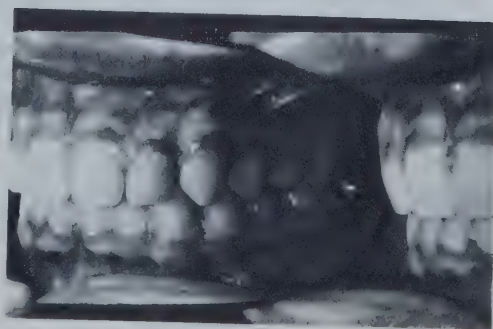


Right Side                          Left Side

Plate 2.    Naturally Occuring Ideal Occlusion

malocclusion.

C. "Severe" Malocclusion was deemed present in those children with a malocclusion complicated by obvious skeletal dysplasias, esthetic problems and/or marked functional problems requiring long-term intensive and complicated treatment.

## V. OBJECTIVE OCCLUSAL APPRAISAL

In an attempt to assess occlusal disorders as quantitatively and as objectively as possible a malocclusion index rating was also carried out for each child in the study.

The malocclusion index accepted by the American Association of Orthodontists (AAO) and the Council on Dental Health of The American Dental Association is the Handicapping Malocclusion Assessment Record (HMAR) developed by the AAO Council on Orthodontic Public Health Service under the chairmanship of J.A. Salzmann[43]. This index (Fig. 8) has a distinct advantage in that assessments may be made quickly and without the need of millimeter measurements.

Subjective malocclusion ratings of the children examined were compared with the HMAR index score and evaluated statistically to determine the correlation between the methods.

## VI. ANALYSIS OF DATA

The data collected during the course of this study was categorized by sex, school, occlusal status and socio-economic status of both child and school.

The data was tested for statistical significance at the University of Alberta Computing Services Centre. The following statistical tests were employed to evaluate the data collected:

1. Chi Square Test ($X^2$) is a test to determine how independent and random

HANDICAPPING MALOCCLUSION ASSESSMENT RECORD

## A. INTRA-ARCH DEVIATION

| SCORE TEETH AFFECTED ONLY | | MISSING | CROWDED | ROTATED | SPACING OPEN | SPACING CLOSED | NO. | POINT VALUE | SCORE |
|---|---|---|---|---|---|---|---|---|---|
| MAXILLA | Ant. | ·· | ·· | ·· | ·· | ·· | | X2 | · |
| | Post. | ·· | ·· | ·· | ·· | ·· | | X1 | |
| MANDIBLE | Ant. | ·· | ·· | ·· | ·· | ·· | | X1 | |
| | Post. | ·· | ·· | ·· | ·· | ·· | | X1 | |
| | | | | | | Total Score | | | |

Ant. = anterior teeth (4 incisors); Post. = posterior teeth
(include canine, premolars and first molar).
No. = number of teeth affected.

## B. INTER-ARCH DEVIATION

### 1. Anterior Segment

| SCORE MAXILLARY TEETH AFFECTED ONLY, EXCEPT OVERBITE* | OVERJET | OVERBITE | CROSSBITE | OPENBITE | NO. | P.V. | SCORE |
|---|---|---|---|---|---|---|---|
| ·· | ·· | ·· | ·· | ·· | | X2 | |
| | | | | Total score | | | |

*Score maxillary or mandibular incisors.
No. = number of teeth affected; P.V. = point value.

### 2. Posterior Segment

| SCORE TEETH AFFECTED ONLY | RELATE MANDIBULAR TO MAXILLARY TEETH | | | | SCORE AFFECTED MAXILLARY TEETH ONLY | | | | NO. | P.V. | SCORE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | DISTAL | | MESIAL | | CROSSBITE | | OPENBITE | | | | |
| | RIGHT | LEFT | RIGHT | LEFT | RIGHT | LEFT | RIGHT | LEFT | | | |
| Canine | ·· | ·· | ·· | ·· | ·· | ·· | ·· | ·· | | X1 | |
| 1st Premolar | ·· | ·· | ·· | ·· | ·· | ·· | ·· | ·· | | X1 | |
| 2nd Premolar | ·· | ·· | ·· | ·· | ·· | ·· | ·· | ·· | | X1 | |
| 1st Molar | ·· | ·· | ·· | ·· | ·· | ·· | ·· | ·· | | X1 | |
| | | | | | | | Total Score | | | | |
| | | | | | | | GRAND TOTAL* | | | | |

No. = number; P.V. = point value;
*Add 8 points, when intra-and inter-arch maxillary
incisor score is 6 or more to denote esthetic handicap.
REMARKS:

ADDITIONAL ASSESSMENT
FOR DIRECT ORAL EXAMINATION ONLY

C. *Dentofacial deviations:* Score 8 points for each deviation.
    1. Lower lip position with teeth in terminal occlusion.
      a. Under maxillary incisors _____
    2. The following deviations in connection with correctible or improvable malocclusion
      are scored as fully handicapping:
      a. Facial and oral clefts_____
      b. Facial asymmetry_____
      c. Functional jaw limitations_____
      d. Occlusal interferences_____
      e. Speech impairment_____

Fig. 8. The Handicapping Malocclusion Assessment Record Form
(From Salzmann, J. A. Am. J. Orthod., 54: 751, 1968)

samples of observations compare in terms of the similarity with which these observations are distributed among several discrete and mutually exclusive categories. The test is an index of the extent to which the observed frequencies are consonant with the null hypothesis that the distribution for the two groups is the same in the population.

2. The Pearson Product Moment Correlation Coefficient (r) is an index of the degree of linear relationship between two variables that is not expressed in the units of one of the variables and therefore is an index that will permit comparisons to be made between different sets of variables. For perfect positive correlation, the "r" value is +1, while for perfect negative correlation the "r" value is -1. If there is no relationship between the variables, then "r" = 0.

3. Kendall's tau C Test is a method of assessing rank correlation. This test is used because the procedures for testing its significance are more precise than for other tests of assessing rank correlation such as the Spearman Coefficient. Kendall's tau test is particularly useful in testing samples of intermediate size[35].

RESULTS

The study was concerned with the prevalence of malocclusion per se and with the severity of malocclusion as presented in each individual examined. Variables contributing to malocclusions rarely occur singly in a specific malocclusion. A combination of variables usually contributes to an individual malocclusion and for this reason the prevalences of separate variables that were included on the orthodontic evaluation form (Fig. 2) (for example, Anterior Crossbite) and contributing to malocclusions in the sample as a whole were not considered part of the objective of this study and will not be reported in the present results.

Consent forms (Fig. 1) were distributed to a total of 600 grade eight students out of a possible 1643 potential subjects in the ten schools selected. Of the total forms distributed, 532 (88.67%) were returned. Parental permission to participate in the study was granted to 496 children (92.23% of those returning forms) while 36 children (6.77% of those returning consent forms) returned consent forms indicating parental refusal to allow participation of their child in the study. Thirty-two children (6.45% of those with parental permission) who had obtained parental permission to participate in the study were not examined because they were either absent at the time of examination or because they were still in the mixed dentition stage of development. Of the 464 children examined, 258 were girls and 206 were boys. The mean age was 13 years and 4 months. Results (Table No. 1) indicated that of the total sample only 3 children (0.65%) had an ideal occlusion. A further 51 children (10.99%) had what was deemed to be acceptable occlusion while the remaining 410 children (88.36%) suffered from varying degrees of malocclusion.

## Table No. 1

## Occlusal and Dental Care Characteristics
## Classified According to Sex

| | Total (464) | | Male (206) | | Female (258) | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Ideal Occlusion | 3 | 0.65 | 1 | 0.22 | 2 | 0.43 |
| Class 1, Acceptable Occl. (Includes Ideal) | 54 | 11.64 | 25 | 12.14 | 29 | 11.24 |
| Malocclusion Present | 410 | 88.36 | 182 | 88.35 | 228 | 88.37 |
| No. Children who have a Dentist | 403 | 86.85 | 181 | 87.86 | 222 | 86.04 |
| No. thinking they had Occlusal "Problem" | 186 | 45.36 | 72 | 39.56 * | 114 | 50.0 * |
| Full-banded Comp. Ortho. Treat Req'd. | 290 | 62.5 (i) | 132 | 28.45 | 158 | 34.05 |
| No. Undergoing or Finished Ortho. Treat. | 48 | 10.34 (ii) | 20 | 4.31 | 28 | 6.03 |
| Missing Perm.        Max. 1st Molars         Mand | 13    32 | 2.8    6.9 | 5    14 | 2.43    6.8 | 8    18 | 3.1    6.98 |

\* Chi Square = 4.45,   df = 1,   Pr. $\leq$ 0.0349

(i) 70.73% of those children with malocclusion required comprehensive full-banded orthodontic treatment.

(ii)  Expressed as a percentage of Total number of children with malocclusion = 11.71%      Boys - 4.88%      Girls - 6.83%

Those children under treatment expressed as a percentage of those requiring treatment = 16.55%    Boys - 6.9%   Girls - 9.65%

Of the 410 children classified as having malocclusion present, 290 (62.5% of sample or 70.73% of those with malocclusion) were deemed to require comprehensive full-banded orthodontic treatment to correct their malocclusion. The 48 children who had received or were receiving comprehensive full-banded orthodontic treatment accounted for 10.34% of the total sample, 11.71% of the total number with malocclusion (410), or 16.55% of the total number (290) requiring full-banded treatment.

Of the children requiring treatment 9.6% of the girls were in fact receiving treatment compared with 6.9% of the boys. The difference between the sexes in this category was not found to be significant.

The recorded observations were tested as to the significance of inter-school differences using the Raw Chi Square Test (Tables No. 2,3,4) and indicated the following results:

1. Sex - No significant differences existed as to sex representation in each school sample.

2. Whether or not the child had a dentist - The schools with the lower socio-economic rating indicated fewer children with a dentist than those schools with the higher socio-economic rating. The differences were significant at the 0.1% level.

3. Missing first permanent molars - The schools at the lower socio-economic level showed more children with missing first molars than those children attending schools with a higher socio-economic rating. Differences among the schools were significant at the 1% level.

4. Those children who thought they had an occlusal problem - Inter-school differences were not found to be significant.

5. Prevalence of malocclusion - Inter-school differences were found to be significant at the 1% level but these differences could not be

Table No. 2

## Classification of Variables by School

| School | S.E.S. Rank | Total Sample | G | B | No. with Dentist G | No. with Dentist B | Missing 1st Mol. Max. G | Missing 1st Mol. Max. B | Missing 1st Mol. Mand. G | Missing 1st Mol. Mand. B | Think Occl. Pr. G | Think Occl. Pr. B | Accept. Occl. G | Accept. Occl. B | Ideal Occl. G | Ideal Occl. B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 4 | 52 | 31 | 21 | 25 | 22 | 1 |  | 2 | 0 | 16 | 8 | 4 | 2 |  |  |
| B | 4 | 45 | 25 | 20 | 18 | 18 | 0 | 0 | 0 | 1 | 15 | 5 | 4 | 4 |  |  |
| C | 1 | 45 | 21 | 24 | 12 | 15 | 2 | 2 | 5 | 3 | 6 | 4 | 5 | 6 | 1 |  |
| D | 1 | 43 | 21 | 22 | 16 | 15 | 1 | 2 | 2 | 4 | 6 | 9 | 3 | 3 |  |  |
| E | 2 | 47 | 27 | 20 | 23 | 20 | 0 | 0 | 4 | 3 | 9 | 5 | 7 | 3 | 1 |  |
| F | 5 | 38 | 24 | 14 | 24 | 14 | 0 | 0 | 0 | 0 | 10 | 8 | 0 | 1 |  |  |
| G | 3 | 49 | 25 | 24 | 24 | 21 | 1 | 0 | 3 | 2 | 11 | 9 | 0 | 2 |  | 1 |
| H | 2 | 61 | 30 | 31 | 30 | 28 | 3 | 1 | 2 | 1 | 13 | 12 | 3 | 3 |  |  |
| I | 5 | 42 | 27 | 15 | 27 | 14 | 0 | 0 | 0 | 0 | 15 | 6 | 2 | 0 |  |  |
| J | 3 | 42 | 27 | 15 | 23 | 14 | 0 | 0 | 0 | 0 | 13 | 6 | 1 | 1 |  |  |
| Totals |  | 464 | 258 | 206 | 222 | 181 | 8 | 5 | 18 | 14 | 114 | 72 | 29 | 25 | 2 | 1 |
|  |  |  |  |  | * |  | ** |  |  |  |  |  | *** |  |  |  |

\* Raw Chi Square = 53.47148, df = 9; Pr. ≤0.0001
\*\* Raw Chi Square = 28.84280, df = 9; Pr. ≤0.007
\*\*\* Raw Chi Square = 23.06982, df = 9; Pr. ≤0.006

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Table No. 3        Classification of Variables by School

| School | S.E.S Rank | Total | Girls | Boys | Malocclusion Mild | Mod. | Severe | Class I G | Class I B | C II-1 G | C II-1 B | C II-2 G | C II-2 B | Class-3 G | Class-3 B | Iatrog. Contrib to Mal. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 4 | 46 | 27 | 19 | 14 | 26 | 6 | 16 | 14 | 10 | 5 | | | 1 | | 3 |
| B | 4 | 37 | 21 | 16 | 10 | 22 | 5 | 11 | 10 | 9 | 3 | 1 | 3 | | | 3 |
| C | 1 | 34 | 16 | 18 | 12 | 18 | 4 | 14 | 13 | 1 | 3 | 1 | 1 | | 1 | 7 |
| D | 1 | 37 | 17 | 20 | 10 | 15 | 12 | 11 | 12 | 5 | 6 | 1 | 2 | | | 6 |
| E | 2 | 37 | 20 | 17 | 6 | 27 | 4 | 11 | 9 | 7 | 5 | 2 | 3 | | | 6 |
| F | 5 | 37 | 24 | 13 | 12 | 18 | 7 | 13 | 7 | 8 | 5 | 1 | 0 | 2 | 1 | 4 |
| G | 3 | 47 | 25 | 22 | 15 | 28 | 4 | 20 | 14 | 4 | 8 | 1 | | | | 6 |
| H | 2 | 55 | 27 | 28 | 18 | 35 | 2 | 23 | 18 | 4 | 8 | | 2 | | | |
| I | 5 | 40 | 25 | 15 | 14 | 22 | 4 | 20 | 11 | 5 | 2 | | 2 | | | 5 |
| J | 3 | 40 | 26 | 14 | 9 | 25 | 6 | 20 | 11 | 5 | 3 | 1 | | | | 3 |
| Totals | | 410* | 228 | 182 | 120 | 236 | 54 | 159 | 119 | 58 | 48 | 8 | 13 | 3 | 2 | 53 |

* Raw Chi Square = 23.06982,   df = 9,   Pr. $\leq 0.006$

Table No. 4

## Classification of Variables by School

| School | S.E.S. Rank | Req. Treat. G | Req. Treat. B | Under Treat. G | Under Treat. B | % Under Treat. | S-E Breakdown of Sample High | S-E Breakdown of Sample Middle | S-E Breakdown of Sample Lower | S-E Breakdown of Treat. Category H | S-E Breakdown of Treat. Category M | S-E Breakdown of Treat. Category L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 4 | 18 | 14 | 5 | 3 | 15.38 | 9 | 35 | 8 | 2 | 5 | 1 |
| B | 4 | 17 | 10 | 6 | 1 | 15.56 | 5 | 32 | 8 | 2 | 5 | |
| C | 1 | 9 | 13 | 0 | 1 | 2.22 | | 11 | 34 | 0 | 1 | 0 |
| D | 1 | 10 | 17 | 0 | 0 | 0 | | 17 | 26 | 0 | 0 | 0 |
| E | 2 | 17 | 14 | 1 | 1 | 4.25 | | 27 | 20 | 0 | 1 | 1 |
| F | 5 | 15 | 10 | 4 | 4 | 21.05 | 8 | 29 | 1 | 2 | 6 | 0 |
| G | 3 | 15 | 17 | 2 | 1 | 6.12 | | 35 | 14 | 0 | 2 | 1 |
| H | 2 | 17 | 20 | 0 | 2 | 3.28 | 2 | 48 | 11 | 0 | 2 | 0 |
| I | 5 | 18 | 8 | 6 | 4 | 23.81 | 6 | 35 | 1 | 2 | 8 | 0 |
| J | 3 | 22 | 9 | 4 | 3 | 16.67 | 1 | 27 | 14 | 0 | 7 | 0 |
| Totals | | 158 | 132 | 28 | 20 | 10.34 | 31 | 296 | 137 | 8 | 37 | 3 |

* Raw Chi Square = 31.72664, df = 9, Pr. $\leq 0.0002$

explained on the basis of the socio-economic status of the schools.

6. Those children with acceptable occlusion - Inter-school differences were found to be significant at the 1% level, but as in (5) no rationale was formulated to explain these differences.

7. Those children requiring treatment - No significant differences existed among the schools.

8. Those children under treatment - The schools with a higher socio-economic rating showed a higher percentage of children under treatment than those schools with a low rating. The differences were significant at the 0.1% level.

Eighty-six and one quarter per cent of the children examined had a dentist. The percentage of those children with a dentist in the lower socio-economic group was lower than those children in the middle and high income categories.

One hundred and eighty-six children (40.9%) thought they had a problem with their teeth. In each of these cases there was, in fact, an obvious esthetic defect involving the six anterior teeth.

Of those children classified as having a malocclusion, 39.56% of the boys thought they had a problem compared with 50% of the girls. A Chi Square test indicated that this difference was significant at the 5% level (Table No. 1).

Thirteen children (2.8% of the total sample) were missing maxillary first permanent molars compared to 32 (6.9%) who were missing mandibular first permanent molars. There were no significant differences as to sex in this category. There is a tendency, however, for more children in the lower socio-economic level to be missing one or more of these teeth.

No significant differences existed among socio-economic levels for

the various occlusal assessment categories (Table No. 5). A significant
correlation existed, however, between the socio-economic rating of the
children and the number of children under orthodontic treatment (Table
No. 6). Only three children (3.57% of those requiring treatment) in the
lower socio-economic level were receiving treatment. Thirty-seven
children (19.89%) were receiving treatment in the middle category and 8
children (40%) were being treated in the high category. A Kendall's tau
C test performed on this data indicated that these differences were signi-
ficant at the 0.1% level.

Fifty-three children (11.42%) had one or more first bicuspids
removed injudiciously resulting in an iatrogenic condition.

Two hundred and seventy-eight children (59.91%) with malocclusions
present were in the Angle Class I category, 106 children (22.84%) were
classified as Class II, Division I malocclusions, 21 children (4.52%) as
Class II, Division II malocclusions and 5 children (1.08%) as Class III
malocclusions. There were no significant sex differences according to
Angle's Classification.

The frequency distribution of the 464 scores collected in this
study together with the mean and mode score for each occlusal status
category is represented in Fig. 9. Cut-off scores were not established
to limit each occlusal status category and thus some overlap between the
range of scores is noted (Fig. 10). The mode and mean of the scores
for each category are well toward the centre of the distribution indicating
general agreement with the subjective ratings of occlusal status.

A high coefficient of correlation existed between subjective rating
of occlusal status and the HMAR index scores as indicated by the Pearson
product-moment correlation coefficient. (Pearson Correlation Coefficient
= 0.8901, Pr. $\leq$ 0.001.)

Table No. 5

Occlusal Assessment Rating Classified According

to Socio-Economic Strata Category

Socio-Economic Strata

| | High | Middle | Lower |
|---|---|---|---|
| Acceptable Occl. (Includes Ideal) | 5 (16.13%) | 29 (9.8%) | 20 (14.6%) |
| Mild Malocclusion | 6 (19.35%) | 81 (27.36%) | 33 (24.09%) |
| Moderate Malocclusion | 19 (61.29%) | 157 (53.04%) | 60 (43.8%) |
| Severe Malocclusion | 1 (3.23%) | 29 (9.8%) | 24 (17.52%) |
| Totals | 31 (100%) | 296 (100%) | 137 (100%) |

Table No. 6

## Malocclusion and Treatment Categories Classified
## According to Socio-Economic Strata

### Socio-Economic Strata

| Malocclusion Category | Total No. | High No. | % | Middle No. | % | Lower No. | % |
|---|---|---|---|---|---|---|---|
| Not Requiring Comprehensive Treatment | 120 | 6 | 5 | 81 | 67.5 | 33 | 27.5 |
| Requiring Comprehensive Treatment (Under Treat.) | 290 (48) | 20 (8) | 6.9 (40) | 186 (37) | 64.14 (19.89) | 84 (3) | 28.97 (3.57) * |
| Total with Malocclusion | 410 | 26 | 6.34 | 267 | 65.12 | 117 | 28.54 |

*Kendall's tau C = 0.13684    Pr. $\leq$ 0.0001

# HMAR INDEX
## Freq. Distribution of Scores
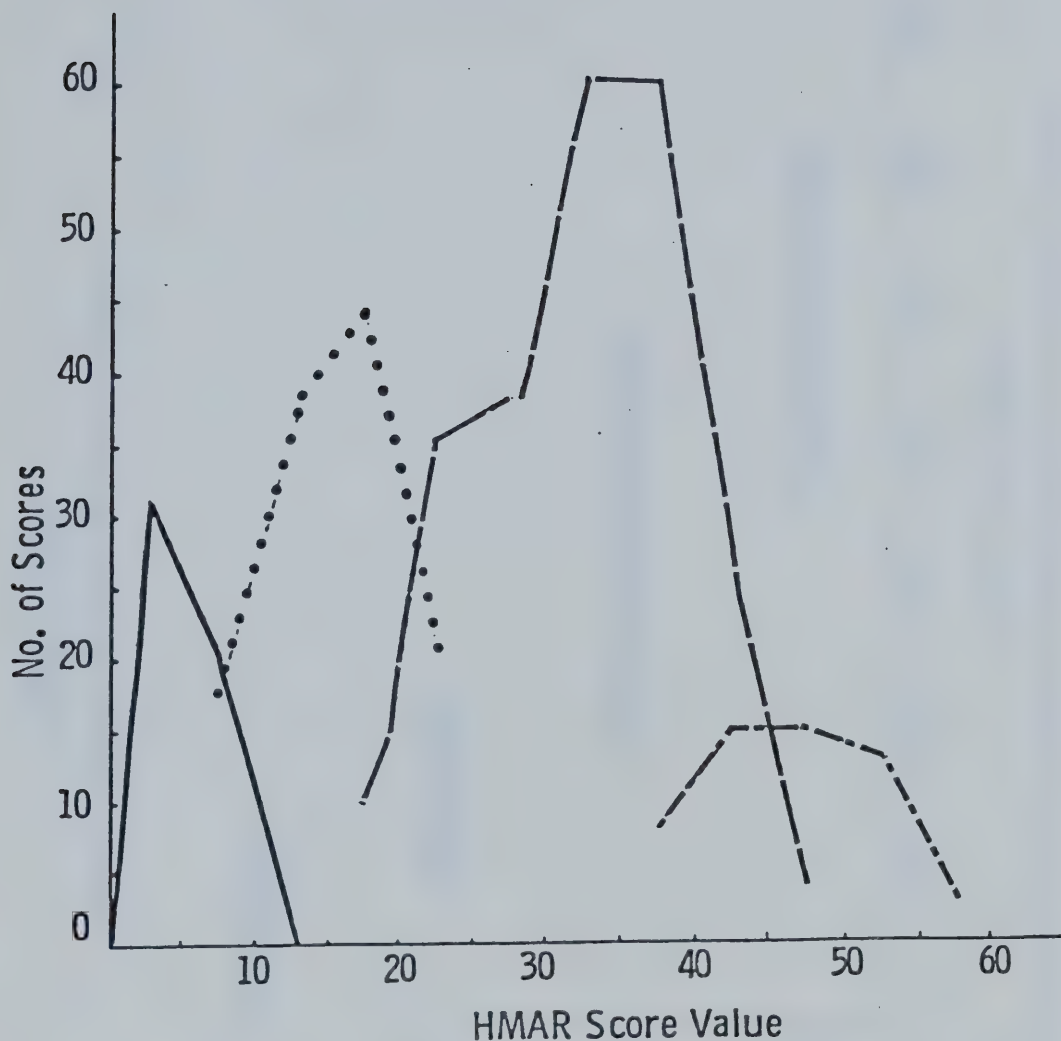


Pearson Correlation Coefficient
Between HMAR Score and Subjective Rating = 0.8901   Pr.≤0.001

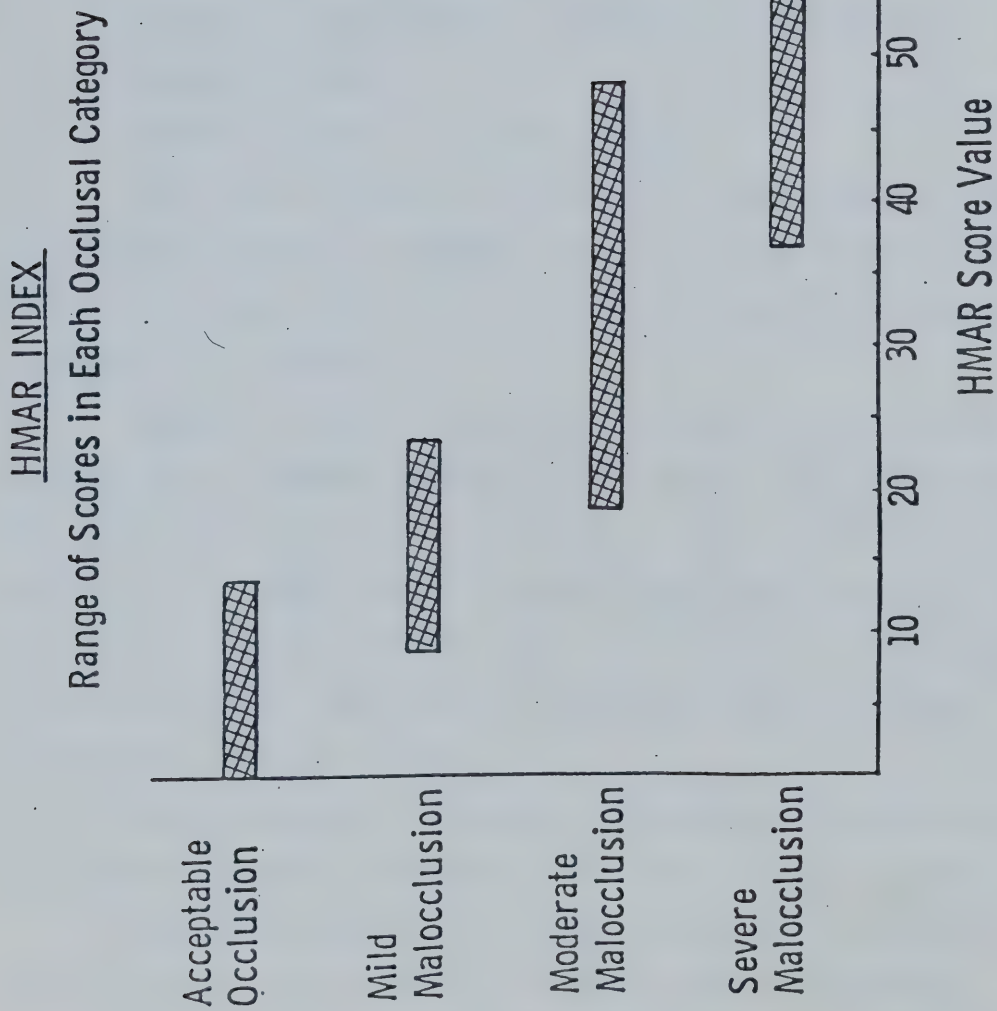Fig. 9.   HMAR Index:   Frequency Distribution of Scores

Fig. 10.  Bar Graph Illustrating Range of HMAR Scores in Each Occlusal Category

DISCUSSION

There are four basic principles by which the epidemiologic method is applied to the study of any disease or anomaly[20], for example, dento-facial anomalies:

1. Define the problem (most important and most difficult).

2. Find the factors of causation.

3. Formulate the principles for a program of control based on demonstrated causes.

4. Evaluate the results of control measures.

This study to determine the prevalence of malocclusion in a sample of grade eight children is confined primarily to the first basic principle. There are two aspects which must be defined: the nature of the problem and the extent of the problem.

Defining the nature of the problem is difficult since in spite of the time spent by numerous investigators in the past, the profession still has no clear definition of what constitutes a malocclusion[29,30]. Malocclusion is not a single entity but rather a collection of disorders, each in itself constituting a problem. Many of the disorders are complicated by a multiplicity of causes and can be reversible through growth and development, or through treatment.

The determination of the number and proportion of persons with malocclusion is greatly influenced by the criteria used for diagnosis.

Considerable improvement is needed in the methods of deciding what constitutes a malocclusion since current methods are imprecise.

The word occlusion is an imprecise word used in an imprecise way. It has a generally acceptable definition: "The manner in which the teeth intercuspate"[47]. The word malocclusion, however, is an imprecise word

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improperly used in a precise way. Malocclusion is commonly used in de-
scribing the prevalence of occlusal disorders. Investigators seem prone
to interpret malocclusion as a discrete variable rather than a combination
of many variables.

Various studies have been carried out reporting the prevalence
of malocclusion and there is wide variation in reporting. The lack of
an adequate definition of malocclusion is probably a main factor in the
variation. The diverse nature of occlusal disorders may preclude the use
of a single definition to adequately describe the nature of malocclusion.

An attempt has been made in this study to rank occlusal status
progressively from "Ideal" to "Acceptable" occlusion and "Mild", "Moderate"
and "Severe" malocclusion. Most dentists and orthodontists have a similar
concept of what constitutes an "Ideal" occlusion but some interexaminer
variablilty would probably exist amongst the other occlusal status cate-
gories since, like malocclusion, the terms describing these categories
are inadequately defined and lack precision. There is an obvious problem
in attempting to confine to discrete categories a multitude of disorders
which increase in severity on a continuous scale and which are influenced
by a number of diverse factors. Subjectivity must enter into this kind
of diagnosis and status analysis since a valid documentation of the
physiologic and psychologic effects of malocclusion on the patient is
lacking.

Defining the extent of the problem is also difficult since pre-
valence figures obtained from studies made to date vary greatly mainly
due to the fact that the criteria of assessment of what is acceptable
and what is undesirable in occlusion have varied with each study. In
spite of different methods employed, however, most examiners found a

high prevalence of malocclusion in the samples studied[30].

A number of investigators[6,8,17,33,34,42] have pointed out that the high prevalence of malocclusion constitutes a Public Health problem. Although there is general agreement that a Public Health problem exists, an area of difficulty lies in the fact that a comprehensive, generally accepted index has not yet been developed to assess the extent and degree of severity of malocclusion.

Moyers[39] states: "Those who think it will be a simple matter to produce an occlusal index analogous to the D.M.F. or similar ratios of carious activity, are naive, blessed with amazing hope or burdened with very little knowledge of occlusal dysfunction". As Moyers and Summers[38] have observed, occlusal disorders are not one problem but a family of problems. Thus occlusal disorders do not constitute a discrete variable, such as a malocclusion is present or absent, but may be found in a continuum from healthy to disabled that Gordon[20] has called the biologic gradient of disease.

The examination was confined to those children whose permanent teeth (exclusive of third molars) had erupted. It is difficult to evaluate the status of a mixed dentition accurately since malocclusion occurring at this stage is sometimes transitional so that any evaluation during this period might be subject to too great an error. Limitation of the study to a narrow age group would further reduce the possibilities of error and facilitate comparison with similar studies or with the same group at a later date. For this reason grade eight children were selected for study since by this stage most of them are in the permanent dentition stage, occlusal problems should be fully manifest, and these children are usually becoming socially aware.

Relying solely on subjective examination analysis in studies to determine the prevalence of malocclusion is fraught with possible bias, since there are as yet no "standard" criteria with which to compare results of other examiners in similar studies.

In an attempt to improve the basis of comparison with other studies the subjective occlusal analysis of each child was supplemented with the HMAR score. The index method therefore serves as a control over the subjective assessment. Although there is no universally accepted index, the index endorsed by the American Association of Orthodontists (AAO) and the Council on Dental Health of the American Dental Association is the Handicapping Malocclusion Assessment Record developed by the AAO Council on Orthodontic Public Health Service under the chairmanship of J.A. Salzmann.

The AAO Index (HMAR) was chosen for direct mouth assessment because it does not require millimeter measurements and because the criteria on which it is based involve easily recognizable dentofacial deviations. Millimeter measurements made in the mouth are subject to considerable error due to the angle at which the measuring device is held, the tendency of the patient to move the mandible during the measuring process, and personal errors in reading instruments.

Allen[1] examined 110 individuals based on criteria employed by the Bureau of Dental Health of the State of New York. He compared the subjective results with the HMAR scores obtained for each individual. He found that a significant correlation between the two assessment procedures existed and was indicative of the practical value of the HMAR. He concluded that direct mouth examination is a valid and practical method of assessment using the HMAR and suggested that this method of examination

could be used in epidemiologic surveys of malocclusion.

Grewe and Hagan[22] in their comparative study of three malocclu-
sion indices, (HMAR, Occlusal Index and the Treatment Priority Index)
stated: "Of the three indices tested in this study, no one index can be
selected over the others with regard to precision or intra or inter-
examiner differences. In measuring precision, intra-examiner variability
was not found to be significant. Inter-examiner variability was not
found to be significant at the 0.05 level as indicated by Pearson product-
moment co-efficients".

The high co-efficient of correlation between HMAR index scores
and subjective evaluation of occlusal status obtained in this study indi-
cates that this index is useful in determining treatment needed in occlu-
sal studies. Although a significant correlation existed between the two
methods of evaluation the HMAR index cannot be relied upon as the sole
indicator of need for orthodontic treatment. The overlap of score ranges
in each occlusal status category was due in part to the fact that the HMAR
index does not quantify occlusal disorders but merely indicates their
presence. Thus a child with numerous mild teeth displacements and not
considered for treatment according to subjective analysis could score
higher than a child with 2 severely rotated maxillary incisors having a
severe esthetic handicap. Although the HMAR shares the deficiencies of
indices in general[9,30,38], it does have value as an adjunct in this type
of study since a significant correlation between scores and subjective
analysis helps corroborate subjective findings.

As in similar studies[4,6] only a very low percentage of the sample
(0.65%) was judged to have ideal occlusion. Acceptable occlusion was
present in only 11.64% of the children. The remainder of the children

(88.36%) were classified as having a malocclusion present. 62.5% of the sample were in need of full-banded treatment to correct a malocclusion. Although the 10.34% of the sample receiving treatment (16.55% of those requiring full-banded treatment) is slightly higher than found in other similar studies[4,6,27] there is nevertheless a large disparity between treatment required and that actually received.

A significant finding was that the percentage of children with malocclusion who were receiving treatment increased progressively from the Low (3.57%) through the Middle income group (19.89%) to the High income group (40%).

Fewer children in the lower income areas of the city had a dentist. More study is needed in this regard to determine whether financial considerations are the principal reason for the lower percentage of children seeking treatment from this group or if perhaps there is also a tendency for lower dental care motivation as indicated by the trend for more children from the Low socio-economic category to be missing first permanent molars.

The Angle Classification method, although useful in the broad description of clinical entities, does not measure the severity of mal-occlusion or the urgency of treatment and has serious shortcomings as a method by which to categorize malocclusion in the general population. It was included here, however, to provide some further basis of compari-son with other studies.

The prevalence of malocclusion according to Angle's Classification (Table No. 2) is similar to that found by other examiners[4,30], although Banack[6] found 36% Class I malocclusion compared with 40% Class II Division I malocclusion and Massler and Frankel[33] found Class III malocclusion in

9.5% of their sample. This examiner found a higher proportion of boys than girls with a Class II, Division II malocclusion. This result is consistent with the findings of Mills[36] and Helm[27]. There were, however, no statistically significant sex differences in the prevalence of malocclusion according to Angle Classification. This result is consistent with previously reported studies[4,30].

The fact that a significant number of children who had first bicuspids removed which resulted in a subsequent compounding of their malocclusion problem has serious implications for dentistry. It would appear that some dentists tend to rely solely on extraction of first bicuspids to improve a crowded dentition. They do not appear to be fully cognizant of untoward changes which can occur in many cases of malocclusion without supportive orthodontic control measures to supplement such extractions.

Esthetic considerations seem to play a large part in determining those who seek orthodontic treatment. Children suffering from an apparently severe functional occlusal disorder were often not aware of the problem. A significantly greater proportion of girls with a malocclusion were aware of their problem (50%) than boys (39.56%). This finding suggests that girls of this age may be more conscious of their appearance than boys.

Apart from determining the prevalence of malocclusion, treatment needs and treatment received for malocclusions in a sample of grade eight children, the results of the study indicate that more information is required with respect to the sociological and psychological aspects of malocclusion. Socio-economic and esthetic considerations play a large part in the decision to seek orthodontic treatment yet a number of indivi-

duals with marked functional occlusal disorders are not receiving treat-
ment for that condition.  Research must continue into the motivating and
limiting factors influencing an individual's decision to seek treatment
for an occlusal disorder.  Such research is necessary in order to provide
meaningful insight to the dental profession, public health authorities
and the public at large as to the nature and extent of occlusal disorders
and how they affect the patients concerned.

CONCLUSIONS

An investigation was conducted on a sample of 464 Edmonton grade eight school children to determine the prevalence and severity of malocclusion and the percentage of children seeking treatment for that condition. From an analysis of the results obtained the following conclusions were drawn:

1.  Of the children examined, 88.36% had malocclusion present. 62.5% required comprehensive full-banded orthodontic treatment to correct their malocclusion.

2.  Of those children requiring comprehensive treatment only 16.55% were being treated.

3.  Only 3 children or 0.65% of the sample had an ideal occlusion. A total of 54 children or 11.64% had acceptable occlusion.

4.  The distribution of malocclusions according to Angle's classification was similar to other studies.

5.  A definite relationship was found between socio-economic level and orthodontic treatment. The higher the socio-economic level, the more likely the child was to have received orthodontic treatment.

6.  A significantly higher percentage of girls with malocclusion thought they had an occlusal problem (50%) compared with 39.56% of boys with malocclusion. Other than this one exception there were no significant differences in the data when classified as to sex.

7.  The removal of first bicuspids in 53 children or 11.42% of the sample was deemed to have contributed to the severity of the mal-

occlusion in those children.

8. The HMAR index can serve as a valuable adjunct in epidemiological studies of malocclusion.

The results of this study indicate a large disparity between treatment required for malocclusions and that actually received by the subjects in this sample. Such a high prevalence of any recognized disorder coupled with a high percentage of untreated cases constitutes a public health problem. The findings indicate a need for increased awareness of the ramifications of malocclusion on the part of the public health authorities, health insurance underwriters, amd especially on the part of the dental profession. On the basis of information obtained in this study one could conclude that practitioners of dentistry should have more training in the diagnosis and treatment of occlusal disorders since the results of this and similar studies indicate that such disorders are the rule rather than the exception.

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